

## **Project Description**

## Anti-Aircraft Creek Culvert Replacement Project Project Description

An existing culvert on Anti-Aircraft Creek at the intersection of Newport Way NW and NW Oakcrest Drive is vulnerable to sedimentation and has low capacity resulting in occasional flooding of Newport Way NW. This project would alleviate the flooding on Newport Way NW by realigning a portion of Anti-Aircraft Creek to its natural drainage pattern. The project consists of replacing existing undersized culverts with larger box culverts and improving the channel grading. The project is located adjacent to and under Newport Way NW, approximately 200 feet south of NW Oakcrest Drive. More specifically, the project is located within the SE  $\frac{1}{4}$  of the SW  $\frac{1}{4}$  of Section 20, Township 24 N, Range 6E, WM, Issaquah, King County, Washington (Figure 1: Vicinity Map).

Anti-Aircraft Creek is a tributary of Tibbetts Creek, which drains to the south end of Lake Sammamish. It is seasonally dry, except during wet, winter months as most of its water comes from stormwater drainage. Anti-Aircraft Creek enters a large wetland on parcel 2024069115 prior to the confluence with Tibbetts Creek. Currently, Anti-Aircraft Creek flows westward in a drainage ditch along Newport Way NW, through a culvert under NW Oakcrest Drive and through parallel culverts across Newport Way NW and into an open channel that outlets into the wetland (Figure 2 – Existing Conditions).

The Anti-Aircraft Creek Culvert Replacement Project includes channel modification and installation of a box culvert underneath Newport Way NW from a City of Issaquah owned parcel directly north of Cougar Mountain Regional Wildland Park onto parcel 2024069115 on the east side of Newport Way NW. The box culvert will replace the ditch along Newport Way NW and the existing culverts and will connect back to the existing Anti-Aircraft Creek channel just west of wetland. The culvert under NW Oakcrest Drive and one of culverts under Newport Way NW will be abandoned in place. The second culvert under Newport Way NW will remain (Figure 3 – Proposed Conditions and Figure 4 - Profile). This project will be concurrent with a residential development on parcel 2024069115.

Approximately 200 linear feet of the existing stream channel will be filled to support the residential development. This equates to 753 SF of fill. This fill will be approximately 50 cubic yards. The existing ditch along Newport Way NW and the remaining portion of Anti-Aircraft Creek will remain unchanged. Disturbed areas will be graded and restored to pre-project conditions.

On the west side of Newport Way NW, prior to the inlet to the proposed box culvert, the Anti-Aircraft Creek channel will be extended for and enhanced with plants and gravel providing an additional 317 square feet of stream channel habitat (20 linear feet) and 1,305 square feet of enhanced channel (92 linear feet). An energy dissipater will be constructed at the outlet of the box culvert on the east side of Newport Way NW. The energy dissipater will consist of a concrete floor

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and baffles that will dissipate the energy in a short distance and minimize downstream erosion. The energy dissipater is 22 linear feet and will include approximately 5 cubic yards of concrete. Downstream of the dissipater, approximately 45 linear feet of new channel and 21 linear feet of the existing Anti-Aircraft Creek channel will be modified and enhanced with clean streambed gravels. This area will create approximately 293 square feet of new and 69 square feet of enhanced stream channel habitat. The channel modification is within the wetland buffer. No portion of the culvert work will occur in the wetland (Figure 3 – Proposed Conditions).

Clean streambed gravels will be placed in the created channel in the wetland buffer and non-native fill will not be placed within the wetland buffer in general. Culvert backfill will largely consist of native materials, except where native materials do not meet gradation specifications. These may include culvert bedding and foundation materials, other minor utility backfills and topsoils. All non-native materials will contain the appropriate environmental and clean material certifications from sources.

Proposed landscaping will include wetland and buffer plants that are native to the area and specific to the conditions of this setting including those well suited for the surrounding soils, hydrologic nature of the area and to the amount of sunlight or shade.

## Memorandum



To: Kerry Ritland, PE - City of Issaquah

From: Dave Segal, PE

Date: October 15, 2015

Subject: Anti-Aircraft Creek Culvert Replacement Project – Supporting Narrative

### **Criteria/analysis of why culvert replacement is not required to meet fish passage standards:**

Anti-Aircraft Creek is currently modeled to show Coho salmon presence by the Washington Department of Fish and Wildlife SalmonScape program. However, two independent reviews both concluded that the portion of Anti-Aircraft Creek upstream of the wetland is not a fish-bearing stream. Both studies came to the same conclusion, as the wetland downstream of our culvert system acts as a fish boundary for upstream reaches. Both studies came to this determination as there is a 1-foot drop at a 16% slope from the wetland to Tibbetts Creek. This drop and slope make it nearly impossible for all juvenile fish to enter the wetland. Within the wetland, there is a 30-foot section where the flow is 75% subsurface and the other 25% of flow is dispersed through the wetland, approximately 25 feet wide. This section of the wetland acts as a fish barrier as the plants and low-flow depth prevent fish from migrating further. In addition, Anti-Aircraft Creek has an intermittent flow regime. That is, the flow is not constant enough to provide adequate flow depth and velocities for fish migration. The independent reviews concluded that the combination of the drop, subsurface flow within the wetland, and an intermittent flow regime make the upstream reaches of Anti-Aircraft Creek non-fish bearing.

In the design process, we first attempted to design a stream simulation culvert that would allow for future fish migration. However, the existing utilities in the roadway limit the location and slope of the new culvert system. After considering all possibilities, the resulting proposed culvert system contains slopes that produce extremely high velocities and low flow depths. The slope, velocities, and flow depths are all inadequate for fish migration.

### **Description of how energy dissipater/stilling basin will control velocities, mimic existing hydrology:**

The energy dissipation structure at the outlet of the culvert system was designed to reduce the velocities of flow as it discharges from the culvert system before entering the wetland. The energy dissipation structure was designed based off the USBR Type III stilling basin to appropriately dissipate energy and decrease velocity of flow. Instead of a concrete-lined structure, we are constructing the basin out of large, blocky sub-angular boulders and woody debris. This is to make the basin more aesthetic to the surrounding residential development. The size of the roughened basin will be nearly identical to the

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calculated USBR Type III size. The angular boulders and woody debris will cause massive turbulence and turn the discharged supercritical flow into subcritical flow.

Our HEC-RAS model calculates the 100-year flow to be exiting the culvert at 14.32 ft/s and leaving the stilling basin at 1.54 ft/s. This drop in velocity allows the flow to then discharge into the wetland at a velocity of 3.25 ft/s, matching existing conditions. One downside is that the stilling basin is not fish passable. Fish will not be able to jump from the basin into the culvert due to a drop, high flow velocities, and the intermittent flows.

#### **Explanation of how proposed culvert replacement project would not increase flooding:**

The results of the hydraulic analysis show that the proposed culvert conveyance system has the ability to convey the 100-year design storm for Anti-Aircraft Creek. In our HEC-RAS model, the hydraulic grade line and water surface level for Anti-Aircraft Creek never overtops the crown of the culvert. In addition, there is a foot of freeboard to act as a factor of safety to ensure that the water surface will not rise above the roadway. In addition to being able to convey the 100-year design storm, the culvert system and the regrading of Anti-Aircraft Creek increases the velocity of the flow upstream and throughout the culvert system. This is important because the underlying problem of the existing system is the buildup of sediment behind culverts. In the existing conditions, the velocity decreases from 5.54 ft/s to 1.47 ft/s as the flow travels from the culvert entrance through the flat section. This decrease in velocity is what causes the sediment to settle and build up behind culverts. For the proposed conditions, the smallest velocity calculated is immediately upstream of the proposed culvert, at 5.33 ft/s. This increased velocity and grade will now be able to transport the sediment through the system.

#### **Regarding existing upstream issues: This project will not address but will not worsen the upstream issue:**

The upstream conditions of Anti-Aircraft Creek show a massive amount of sediment transport. Certain areas of Anti-Aircraft Creek experience high energy flows that erode the channel banks. Immediately upstream of the project area, the creek parallels NW Oakcrest Drive, to the south of a row of residential homes. During site visits conducted in spring 2015, we observed a drop of about 10 feet in the channel bed between the fifth and sixth houses located west of the intersection of Newport Way NW and NW Oakcrest Drive. Downstream of the drop, the channel is incised with walls approximately 8 feet high and a channel width of about 4 feet. Upstream of the drop, we observed a more stable channel morphology with a much wider measured bankfull width of approximately 14 feet. The observed stable stream channel continues for about 100 yards upstream before channel incision is observed again. This incised reach is very similar to the incision downstream, continuing for about 200 feet upstream before forming back into a more stable looking stream morphology.

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We believe the sedimentation issue stems from upstream conditions where we observed extensive erosion and incision of the creek. Addressing upstream conditions is not in the scope of this project but may be considered at a future date.

For our project, we have designed the culvert to be able to transport the upstream sediment load. Based on the channel geometry, morphology, and the hydraulic properties, it was determined that for the 2-year storm, a sediment particle the size of 48 mm or 1.9 inches has the ability to transport through our system. In addition to incipient motion analysis, we have designed the culvert conveyance system and regraded the stream so that the velocities upstream and through the proposed culvert system is greater than the existing system. The proposed culvert system and stream regrading will not cause upstream issues. The system can convey the flow and transport the sediment load. In addition, the HEC-RAS model shows no evidence of backwater that would have an upstream effect.